March 2023

Despite spring break in the middle of the month, March has marked monumental progress for Penn State Formula Racing. With our trip to the Ford Wind Tunnel in Dearborn, MI next month, everyone on the team is grinding out tasks and we couldn’t be prouder! We are looking forward to next month and a continuation of our progress.
Captain’s Note

Friends of Penn State Formula Racing,

There’s a palpable buzz throughout the workshop this time of year – not the literal buzz of tools and machines, but rather a buzz of anticipation. The space is never empty nowadays as members from across all disciplines make a beeline to the Sackett basement after class to work on their projects. This newsletter comes during a monumental week for PSFR, as the team begins to round a manufacturing corner and continues its preparations for an ever-more-looming June competition.

Spring Break and the weeks since have meant some significant progress on manufacturing around the team, with members spending parts of their breaks machining. In particular, Suspension has been hard at work, with manufacturing having been started or completed for a number of the most critical components. After passing the necessary FSAE inspections, our team-first fully composite chassis is being cut and laid as I speak, and will go into the oven to cure within days. The Electronics teams are awaiting their final approvals from officials, which will greenlight the final parts of the tractive system, and in the meantime, several important safety circuits are undergoing extensive testing. From one day to the next, progress is steady and measurable, and I’m proud of the way we’ve collectively answered the call to action in this critical phase of the year.

Also in the past month, we received a new sponsor and held a handful of both professional and social events. We welcomed representatives from Cummins to our shop, where our members were able to network and share in technical discussions. This experience was invaluable to us, and we hope to have more events like this again in the near future! Members of our team also attended a formal in conjunction with several other clubs – we had a blast!

The home stretch is very much upon us, and you can expect to see some incredibly exciting stuff coming in the pages of this newsletter as well as those upcoming. As always, thank you for your support and enjoy!

Best regards,

Nate Dreyer, Team Captain
# Events

## Cummins & Boeing Visits

On March 14th, members from Cummins visited our workshop and talked to our members about our car and team. On March 28th, members from Boeing also visited our workshop and interacted with our team members. These sessions both served as amazing learning experiences from a recruiter perspective and helped some of our newer members understand how we can aid them as a team professionally. A big thank you to all of our members who attended and both Cummins and Boeing for sending representatives to visit us!

## Learning Factory Open House & SWE Accepted Students Program

Also on March 14th, we were invited to attend the Learning Factory's Open House this semester. On March 23rd, we attended the Society of Women Engineers' Accepted Students Program, which focuses on connecting accepted engineering students with engineering clubs. Our members had a blast talking to current and prospective students about the team at both events!
Subsystem Updates

Aerodynamics

This month, the Aero subsystems have continued the big push to finish manufacturing before our wind tunnel date on April 14th. This has included manufacturing all but four of our 22 airfoils, including some of the larger elements like the front wing main element, which can be seen in the picture below.

In addition to manufacturing many airfoils, we have begun the process of manufacturing our tunnels and undertray by having molds cut from the same foam and facilities Chassis uses to make the monocoque. These molds were made in 3 pieces for each side which will need to be bonded and sanded prior to performing any layups. Once these molds have been processed we will use wet layups and carbon fiber sandwich panels to create these tunnels in a similar fashion to how the monocoque is produced. The molds for these parts are pictured below.
Aerodynamics cont.

Finally, in preparation for all the testing we will be performing at the Ford wind tunnel we have begun running CFD simulations to try and validate any results we get from this testing. This data will be extremely useful in future years to prove that our simulations can accurately predict what changes in our package will produce. By comparing our CFD data to real world results we can draw a relationship between these two sets of data and get a much better idea of how much our results will vary moving from computer software to on track performance. Part of the setup for these simulations was testing new meshing parameters, the results of which are seen below.

Chassis

This March has been all about molds for chassis. Last month we made the molds themselves but this month has been all about post processing. Our lovely members have spent countless hours sanding in order to make the molds as smooth as possible and to remove imperfections. We also had to spend time in order to both cut and grind off excess fiberglass from the molds themselves to ensure a smooth connection with previous molds. As we near the end of the month we are hoping to begin the layups so we can have a chassis done in time for wind tunnel testing in just about two weeks. This month we also took apart some of the old chassis to remove the tube frame and grab the parts to reuse for the roll hoop. We will soon be spending time on remanufacturing it by welding it together. Next month highlights are the wind tunnel testing and the finishing up of our main projects (the hoop and the chassis itself).
**Controls, Brakes, and Safety**

The Controls, Brakes, and Safety subsystem is making good headway through the manufacturing stage. We are starting to feel some pressure for the April 14th deadline to have our steering and braking systems fully installed and functioning, so we have been in Penn State’s Learning Factory everyday manufacturing. The pedal tray is the farthest along and getting close to assembly with only a few more days remaining to post process the water jetted parts. The brake pedal needs to have the pockets that we designed to reduce weight CNC milled and the base plate has a few more holes to be drilled. The steering system is also coming along. We just received the water jetted pieces from Send Cut Send that will be welded together to become the steering column mount. The steering column itself also needs to be welded, so we expect a lot of welding to occur this coming week. We are excited to slowly make our way to having a moving car and I (Will Sigety, CBS Lead) hope you all are too!

**Drivetrain**

Drivetrain is making great progress with the end of the year in sight. The motor and differential mount holes have been added and the assembly is ready to be pressed together. Drivetrain and High-Voltage plan on coordinating an assembly plate to allow for testing and reviewing of all the electronic and mounting components before finally bolting everything in the car. The cooling tubes have also been ordered and are ready to implement when the chassis is finished. Drivetrain’s last challenge beside testing is the sprocket adapter. The sprocket adapter blank is in the shop and the current plan is to CNC the blank. Overall, I (Josh Kaleida, Drivetrain Lead) am very happy with the progress of the Drivetrain subsystem throughout the semester. A lot of work has been put into the designs to stay ahead of schedule and I am proud of all of the members for the amount of dedication shown throughout the year.

**Finance**

March was a big month for Finance. On the 14th we welcomed our sponsors Cummins to the shop for a recruiting event. We really appreciated Cummins coming and talking to our members. This month we also started focusing on the Cost Report and Business Presentation. These two events are the subsystem's direct contribution to our competition.
High Voltage Electronics

This month, High Voltage Electronics is going full throttle on manufacturing and continuing to refine the Electrical Systems Form safety document. A large section of our high voltage conductors and relays were confirmed to be safe and within spec by FSAE officials; This means we were able to order a host of connectors and the main relays for our battery pack. These components are currently being integrated into the electrical system layout out of the car. We are using this space as a comprehensive test bench for each component of the electrical system as it comes in. We experienced a slight setback in the manufacturing of the battery container (Accumulator Container). A section that was previously planned to print out of fire resistant ABS plastic now must be made of metal like the rest of the container. This means we have been back in the learning factory machining and welding. While this sets our timeline back, we will be able to make up for the lost time with a little extra effort. Additionally, we have been working with the LV software team on the startup sequence of the car including the timing/actuation of the enable signal for the pre-charge circuitry. We are making a set start-up sequence to avoid any potential edge cases that are unaccounted for. In addition to this, the LV software team helped to flash the software on our BMS temperature sensor module so that it is compatible with the Enepaq LI battery cells we are using for this year’s car. Looking forward, we will finish up manufacturing for all major components and we are hoping to have HV power available for testing in the next 2-3 weeks depending somewhat on the ESF reviewers timeline. Lots of refining and fine-tuning left to finish up, but we are in a good place as long as we keep the pedal down for the rest of the semester.

Low Voltage Electronics

The Low-Voltage team has been hard at work with testing and integrating the new circuit boards. Three of the boards, the power-distribution board, the high-voltage indicator, and the fuse board all worked successfully upon testing! Additionally, unexpected behavior of the pre-charge/discharge circuit, brake plausibility system, and tractive system active light have been root-caused and a revision-round of boards has been ordered. Integration with safety shutdown system has continued and the majority of components have been successfully integrated into the system.

On the firmware side of Low-Voltage, critical vehicle functionality has been achieved with the Teensy microcontrollers! However, because of the limit capabilities of the board, a second firmware solution with extended functionality is being implemented using a STM32 microcontroller running a real-time operating system (RTOS). The structure of this solution has been set up and tasks running on the STM32 microcontroller are now being developed by several of the Low-Voltage team members.
Outreach

March was a busy month despite the nice break included. The design for the livery is complete and we are working on logistics and timing of putting the design on the car. Outreach planned a formal alongside other clubs such as AVT and Car Club, and had a blast attending events like the Learning Factory Open House and the Society of Women Engineers' Accepted Students Program to talk to prospective members about the team. Project managers and subsystems are going to be featured on the Instagram soon so keep your eyes peeled for some faces that may be newer to our socials! Some Outreach members have also been helping with the FSAE business presentation event alongside Finance. We are hopeful that we are going to perform well!

We are still in the process of doing alumni social media features - if you are an alumni interested in being featured on our Facebook, Instagram, and/or newsletter, please fill out this link: https://forms.gle/iw84Aph4itegWXRJA. If you are an alumni or an individual interested in representing your company and willing to talk with us about what you currently do and any tips or tricks on moving from college into a professional field, please reach out to our Outreach Lead, Lauren Waer (lmw5895@psu.edu)! Also make sure to follow and keep updated with all of our social media, including Facebook, Instagram, and TikTok, where all of the usernames can be found on page 9.

Suspension

Manufacturing was the name of the game for March. We are prioritizing all of the parts that we need for the Ford wind tunnel. The parts we completed include the rear shock clevis (pictured below) and rear ball joint holders (2/4 pictured below). The next parts we will manufacture include the carbon A-Arms, rear clevises and various bushings and bearings. After Ford, we will manufacture the rear uprights and anti-roll bars.
Sponsorships

Thank you to our sponsors for the year thus far:
• Altair, Altium, BEST Center, Calspan Tire Research Facility, MasterCAM, Penn State Department of Mechanical Engineering, Penn State Engineering & Entrepreneurship Program, Penn State Engineering Undergraduate Program, Penn State Institute of Energy and the Environment, Rapid Harness, Rock West Composites, SimScale, Stackpole Engineering, The Piper Group, Uline, and VI-Grade

We are looking forward to your continued support.

Acknowledgements

We would like to take the time to acknowledge the following groups:
• Cummins
• Boeing
• The Learning Factory Staff
• Society of Women Engineers

And thank you to all others who have provided us with constant support throughout our switch to electric.

Contact Us

Interested in joining or sponsorship opportunities?
Please contact our team administration below or keep updated with our social media.

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